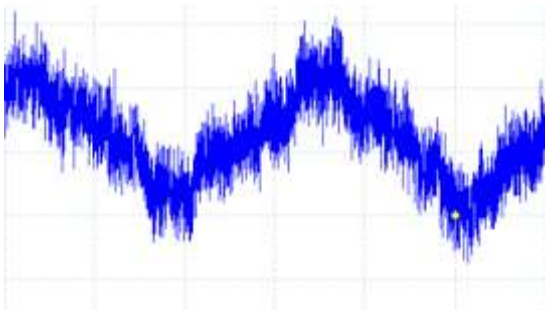
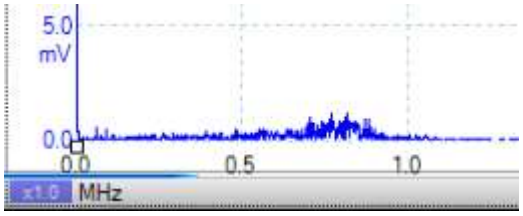
Appendix A: Waveforms and Spectra

Site A: Ginger Thompson's

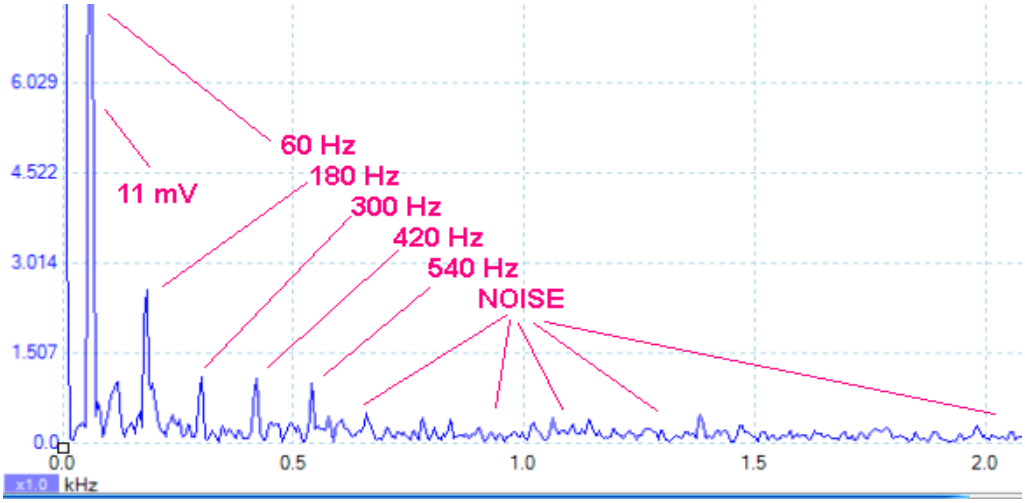


*60 Hz Ground/Grounding Current + EMI induced in Gaussmeter (**M-field**) test leads*

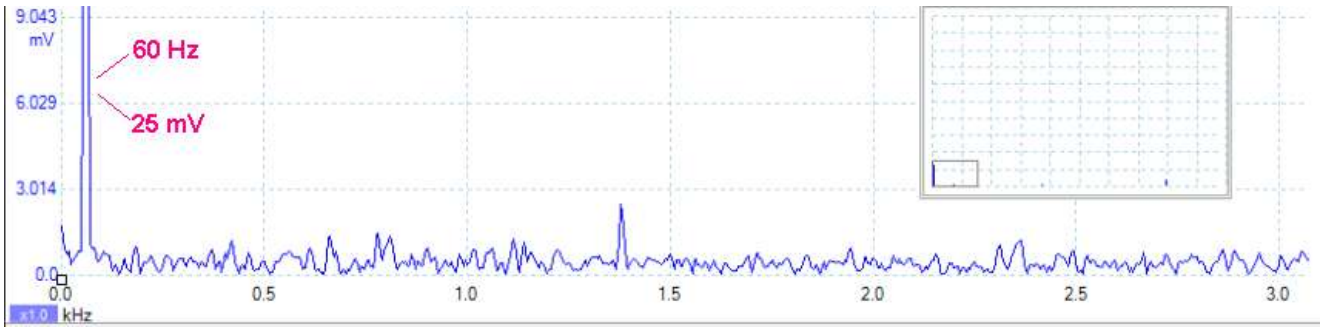


EMI Spectrum

EMI close-up



***M-field** Ground / Grounding Current and Electrical Noise – Note 3rd, 5th, 7th, and 9th Harmonics*



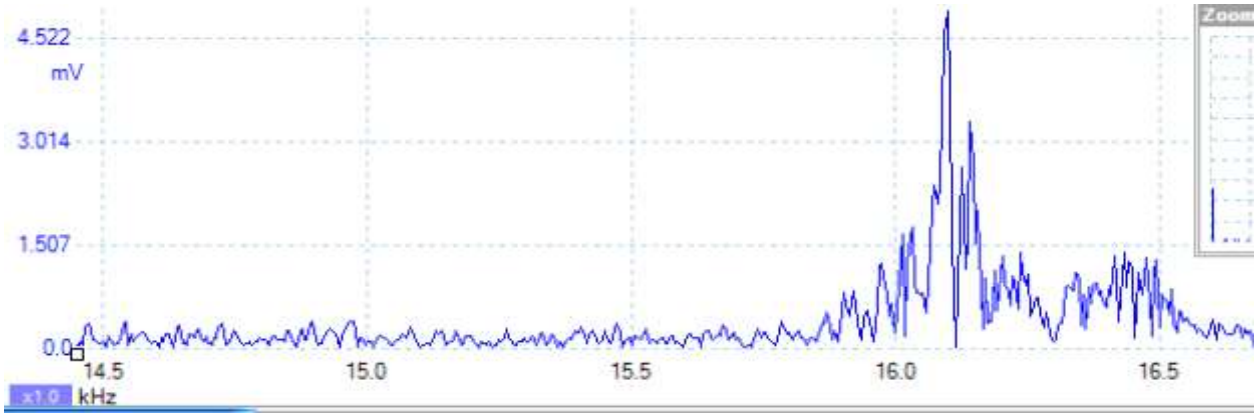
***E-Field** from 7200 V Primary, Minimal Current & No Harmonics, but lots of Electrical Noise*

*Wide-band EMI induced in **E-field** pickup*

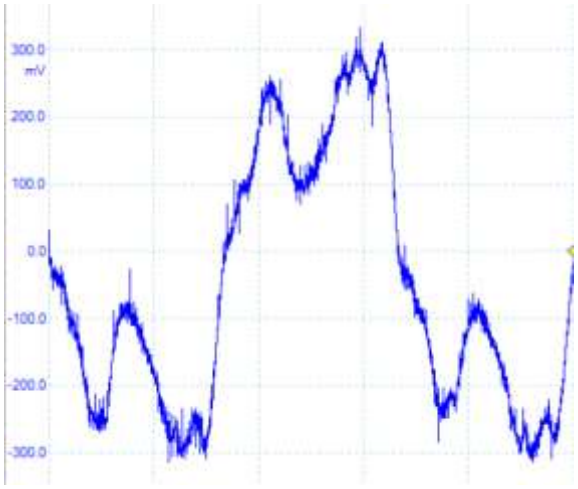
Close-up of right side of above capture

Progressive EMI (close-up of left corner of first graph above)

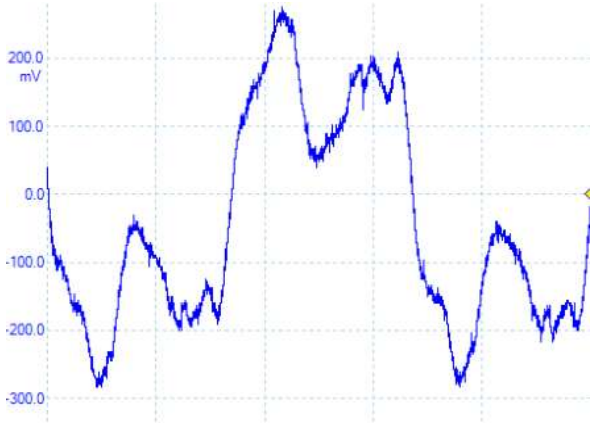
Progressive EMI a few seconds later



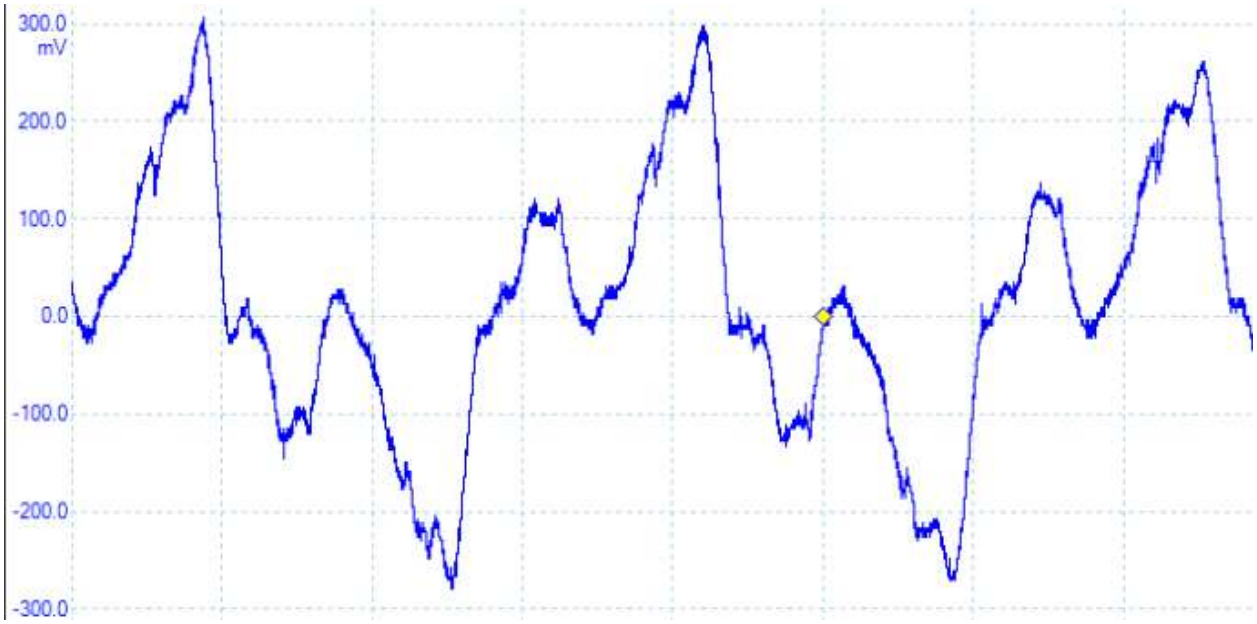
Progressive EMI a few more seconds later



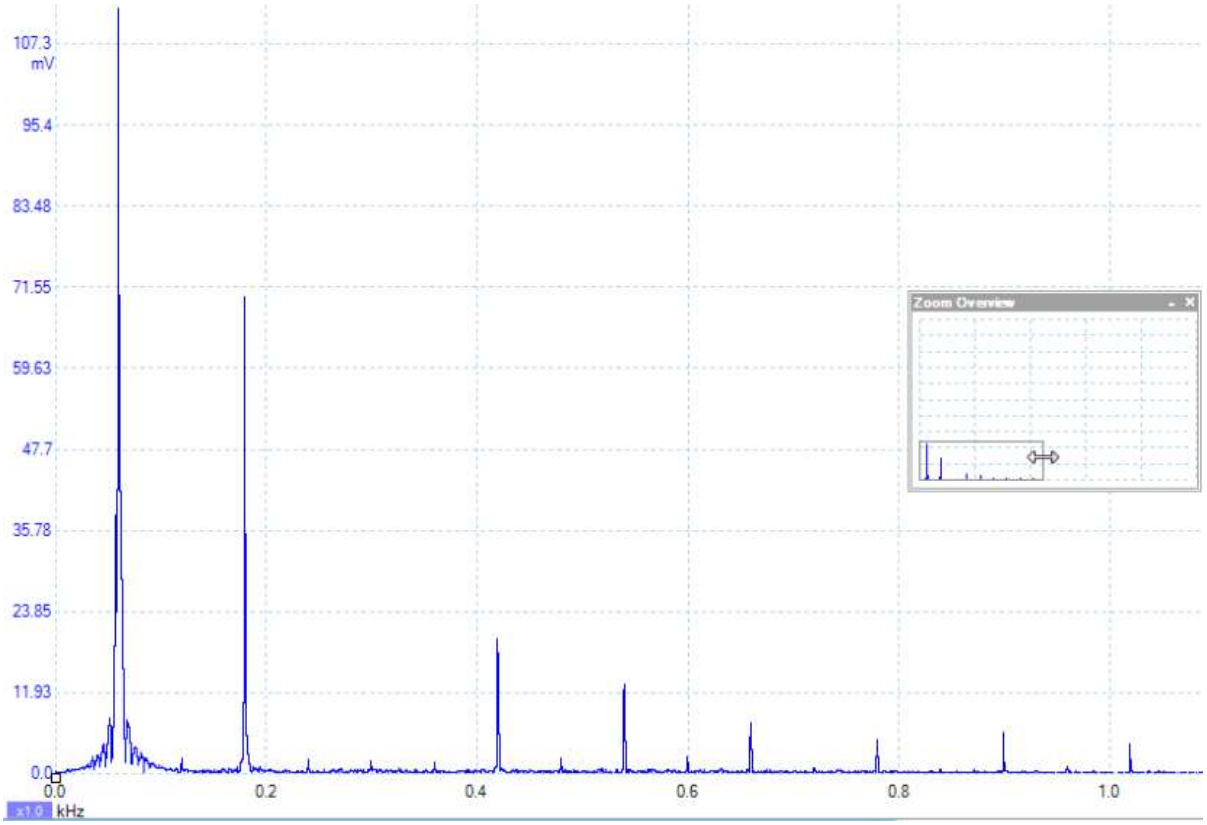
Neutral-Earth Voltage *- Power ON*



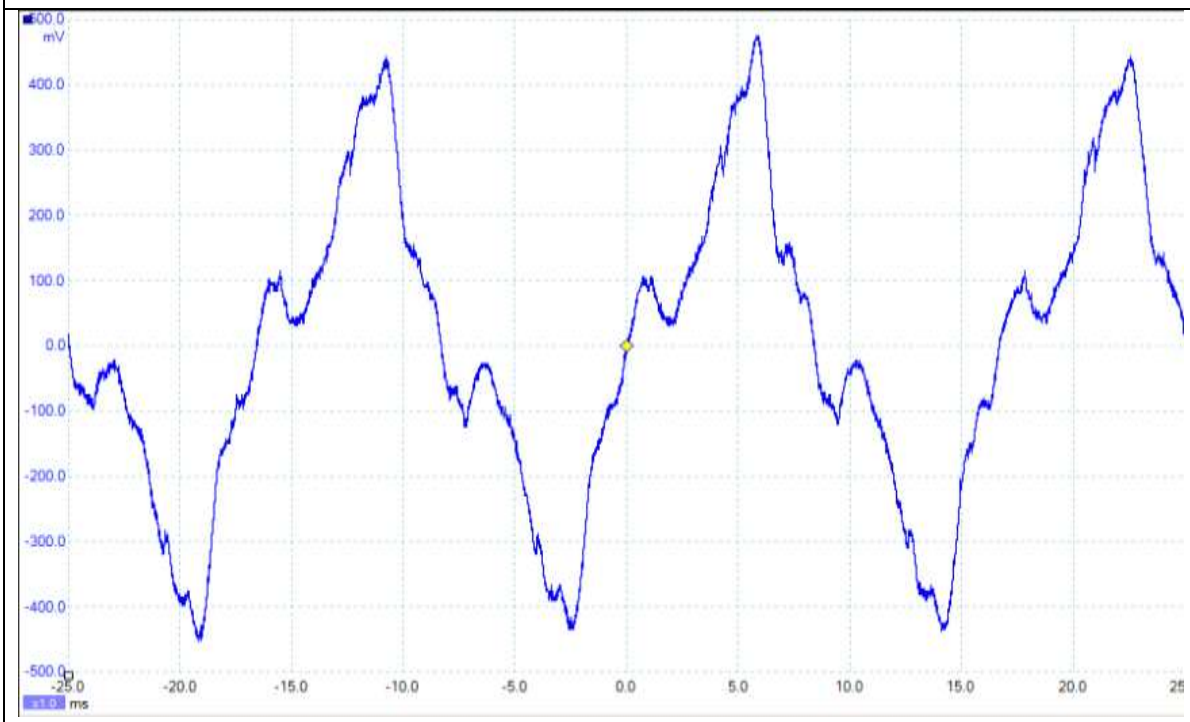
Neutral-Earth Voltage *- Power ON*



Neutral-Earth Voltage *– <u>Power OFF</u> –* ***Note this is 3-phase power***

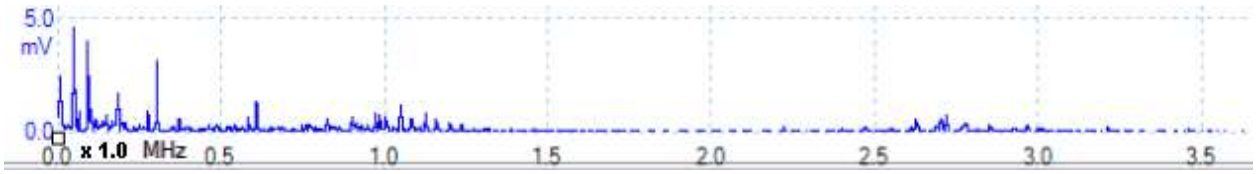


Neutral-Earth Voltage *– <u>Power OFF</u> – Note 3rd, 7th, 9th, 11th, 13th, 15th, and 17th Harmonics, and note the presence of new harmonics and absence of the 5th harmonic (300 Hz) which was present with power on*



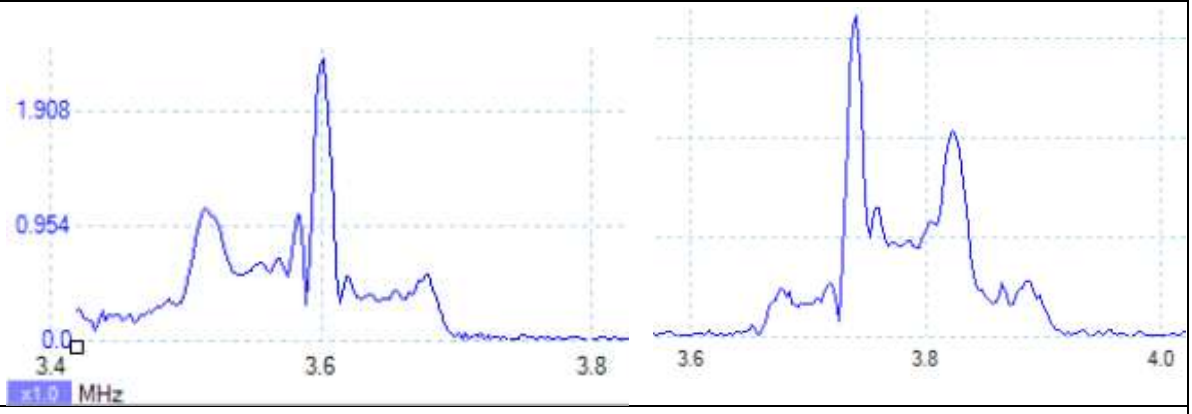
Neutral-Earth Voltage *– <u>Power OFF</u> – Note instantaneous size changes from previous capture*

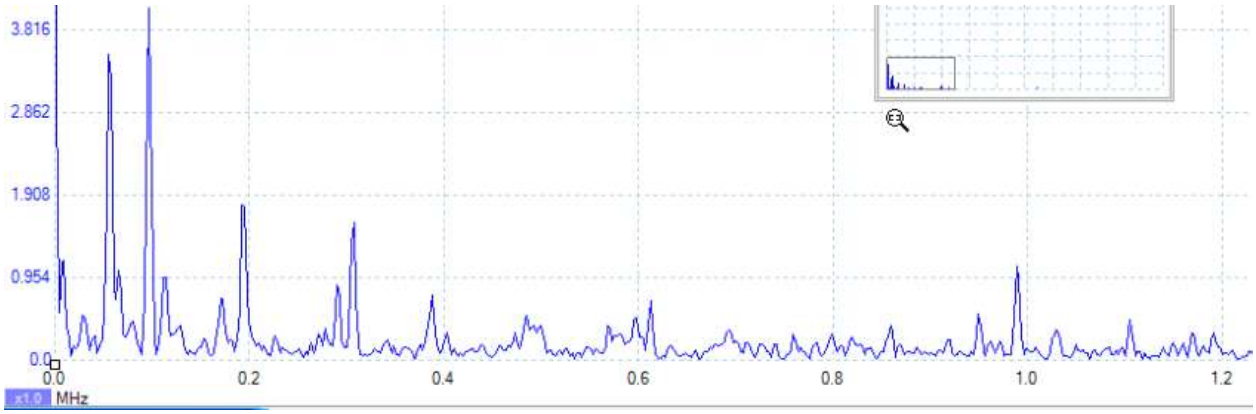
Site B: Rowena Elliott's



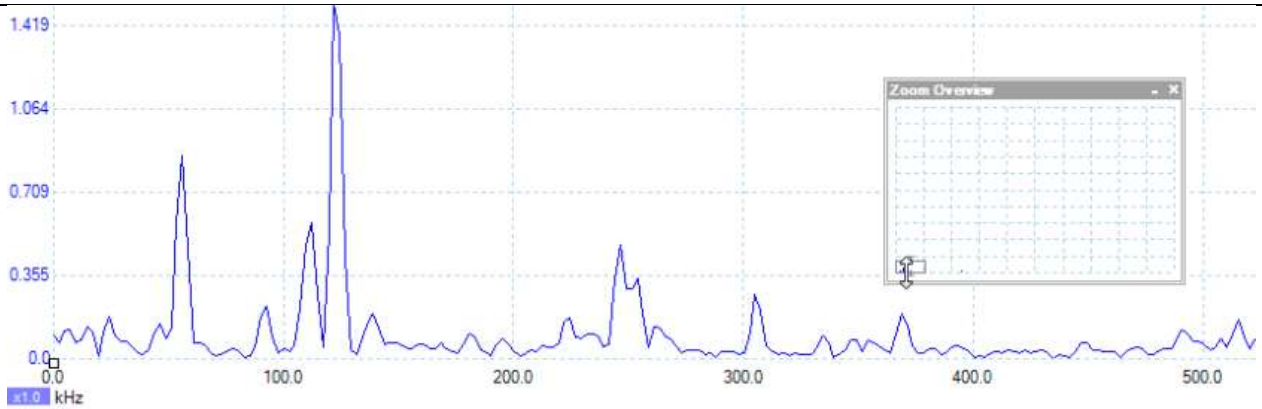
EMI induced in Gaussmeter (M-field) test leads

Erratic EMI bursts occurring between about 3 MHz and 4.5 MHz

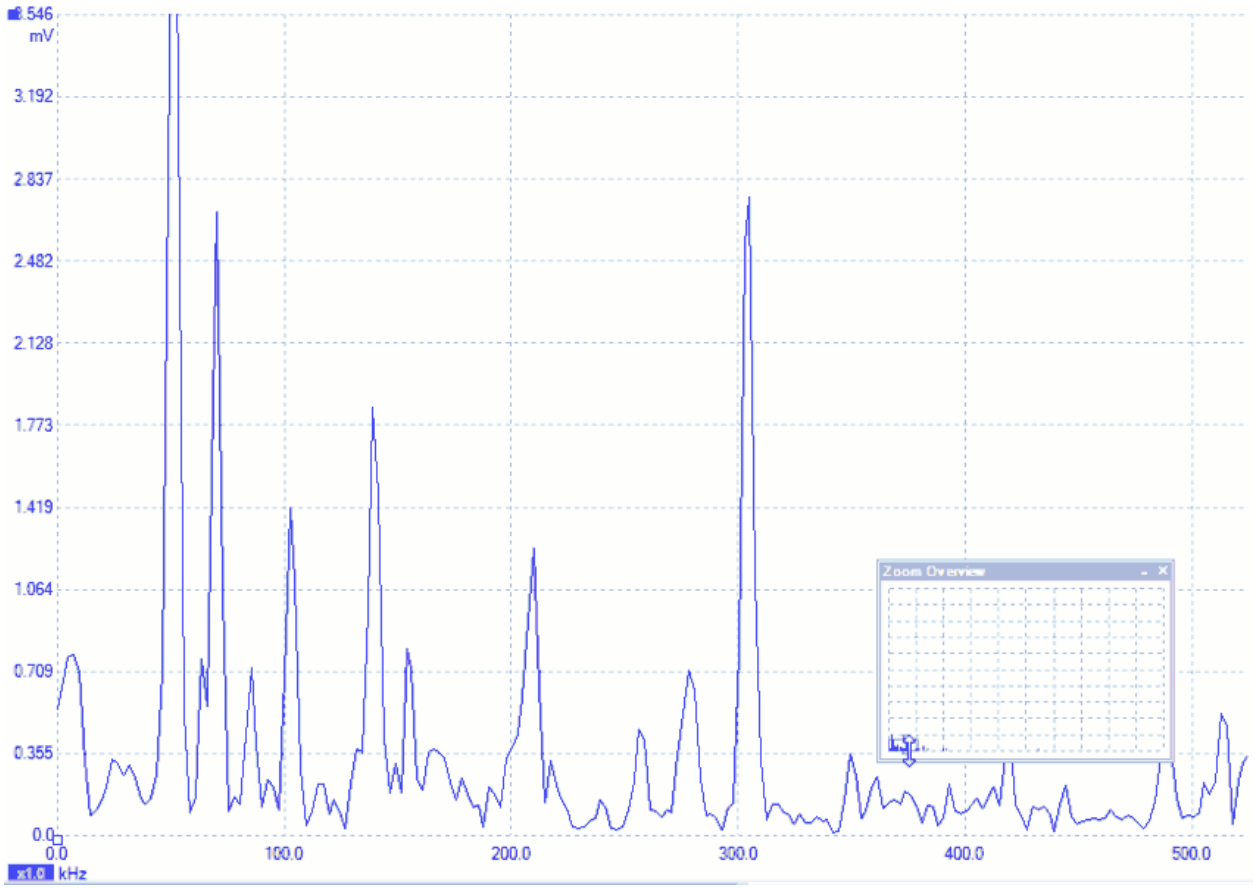




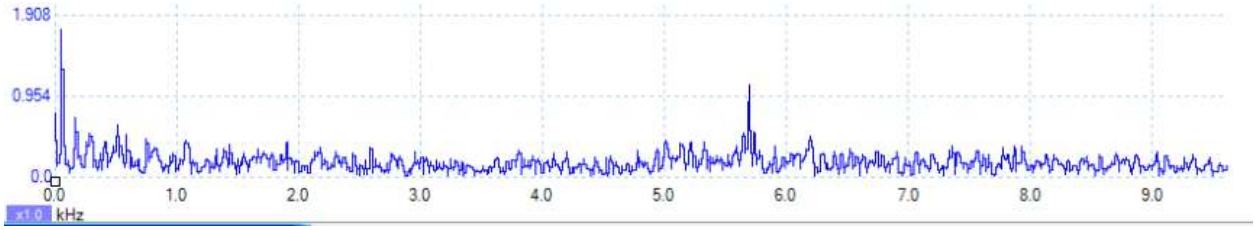
Ongoing EMI onto Gaussmeter leads, all frequencies above 0.1MHz (100 KHz) induced into leads



EMI onto Gaussmeter leads (above 100 on this scale), Close-up

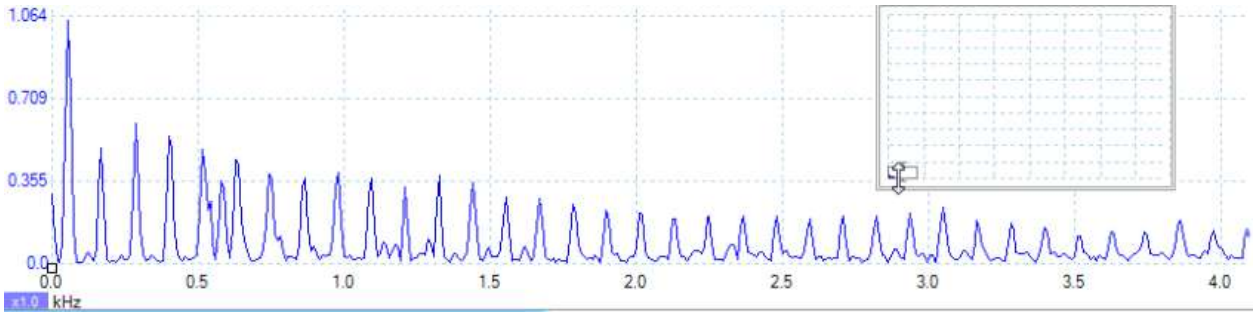


EMI onto Gaussmeter leads, Close-up, note instantaneous quantum leaps in intensity



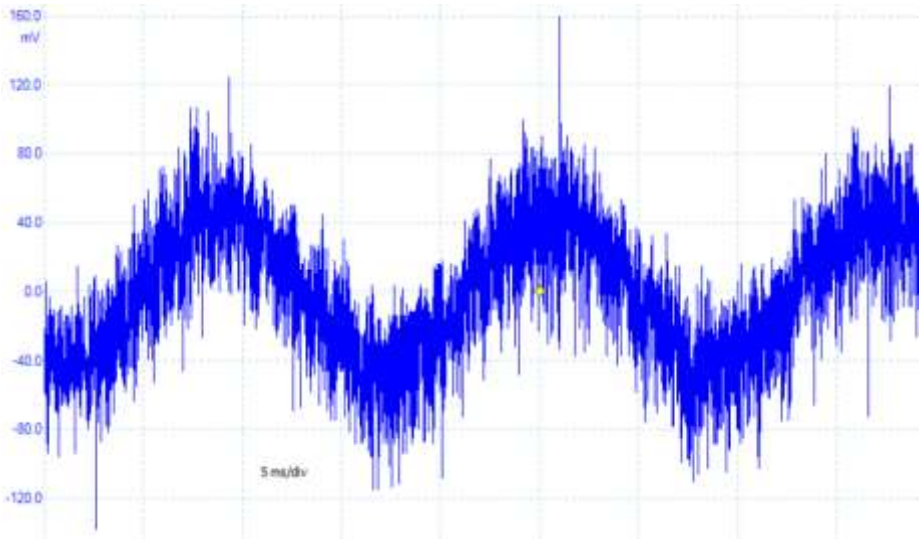
Pervasive Wide-band EMI

Power Frequency Harmonics, note reduced Fundamental (60 Hz)

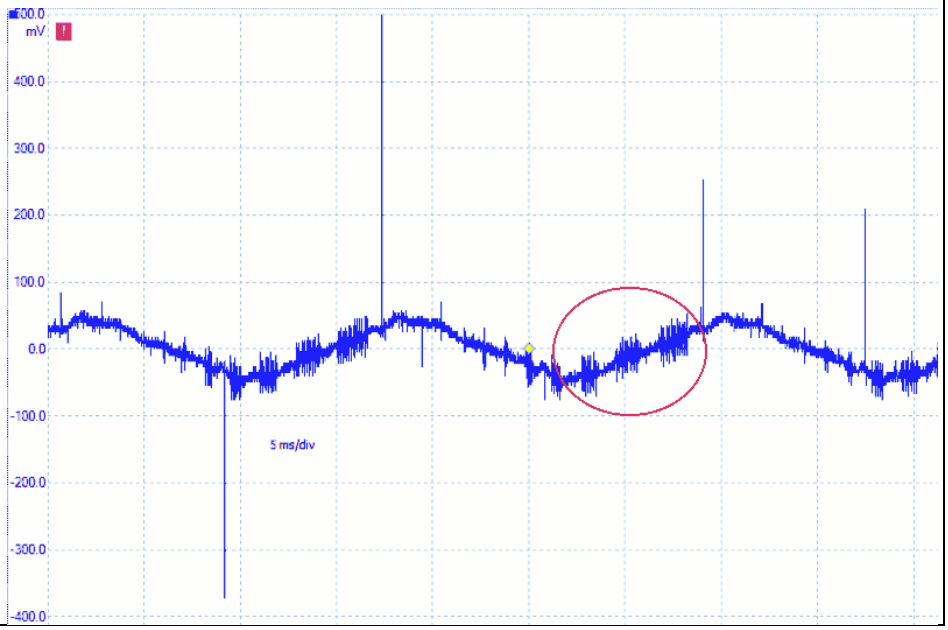


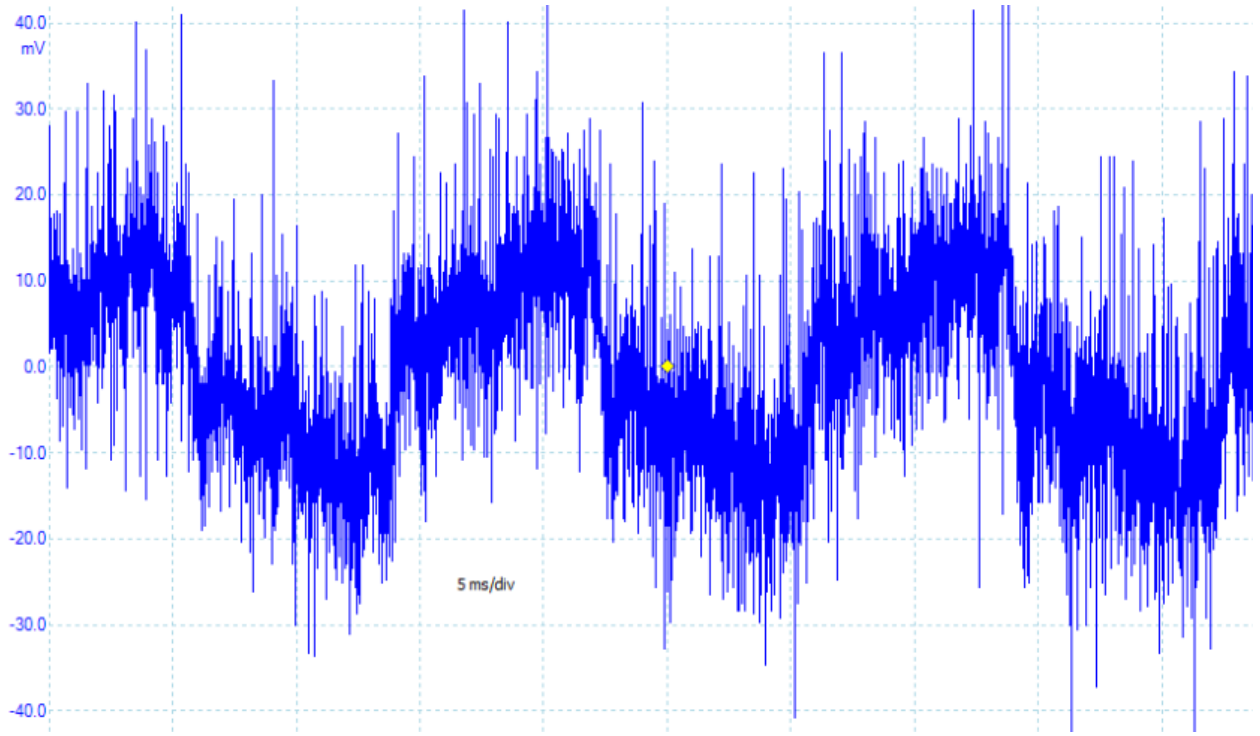
Power Frequency Harmonics, Close-up, 60 Hz prominent (first spike)

***Electric Field** pickup from power line and EMI*

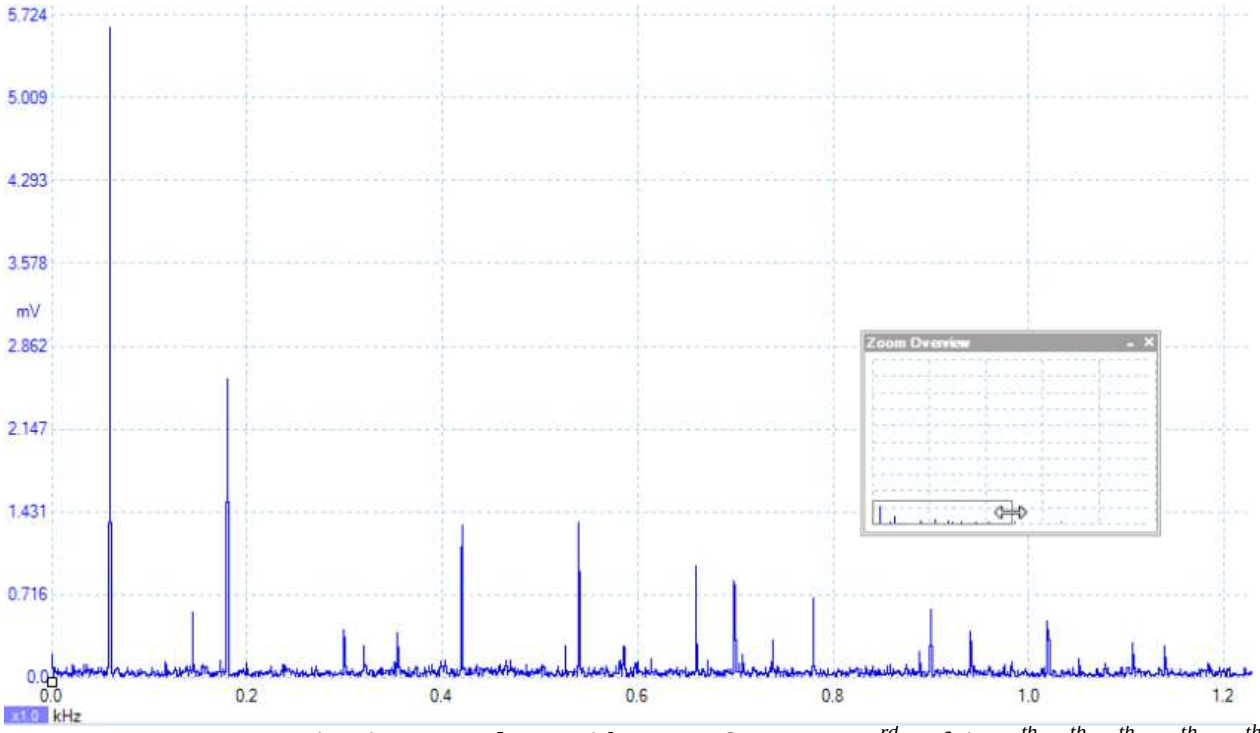


***Neutral to Earth Voltage**, Power ON. Note highlighted area with higher frequency bursts riding on top of the 60 Hz wave, their frequency being some 100 times faster, or about 6000 Hz. This contribution, to devices that are designed to use only 60 Hz, can produce equipment heating that it is not designed for, and may accelerate equipment failure.*



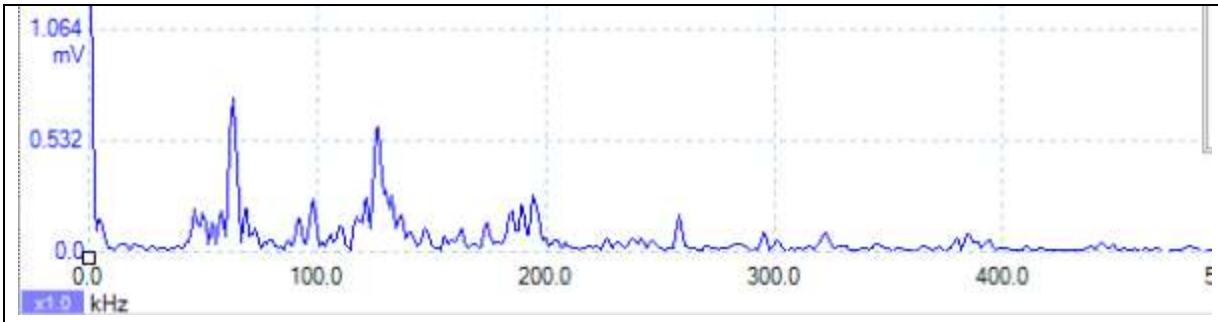


***Neutral to Earth Voltage**, Power ON, Close-up, note the faint resemblance to 60 Hz*

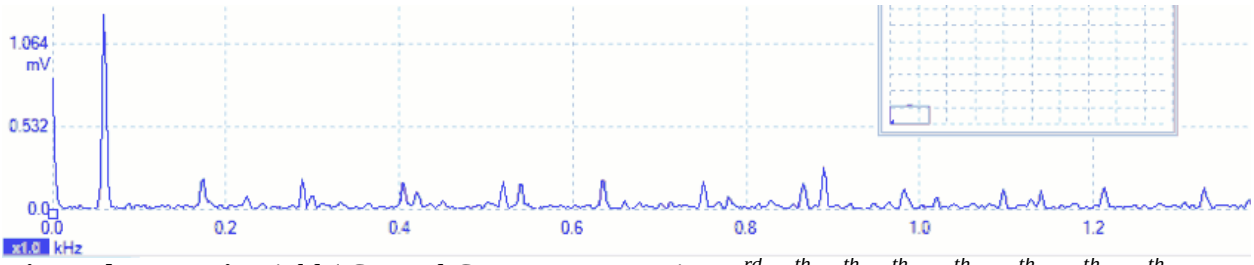


*Power Frequency Harmonics, in **N-E Voltage** <u>with power OFF</u>. Note 3rd, a faint 5th, 7th, 9th, 11th, 13th, 15th, and 17th Harmonics, but also note that other peaks are not harmonics and constitute electrical noise, or Electromagnetic Interference (EMI)*

Site C: Kumeyaay Wind Substation



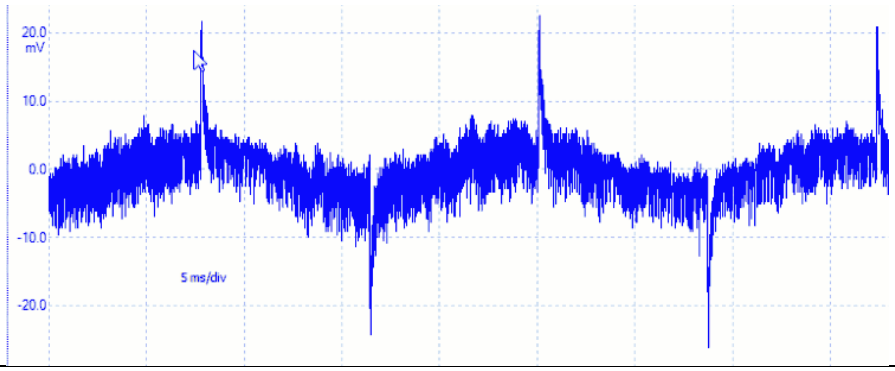
Vertical Magnetic *Field to 100 KHz, and EMI induced onto meter leads beyond that.*

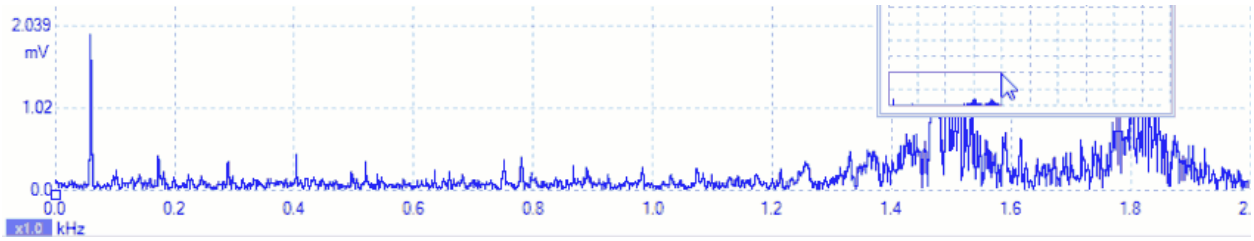


Horizontal Magnetic *Field / Ground Current. Harmonics: 3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th, etc.*

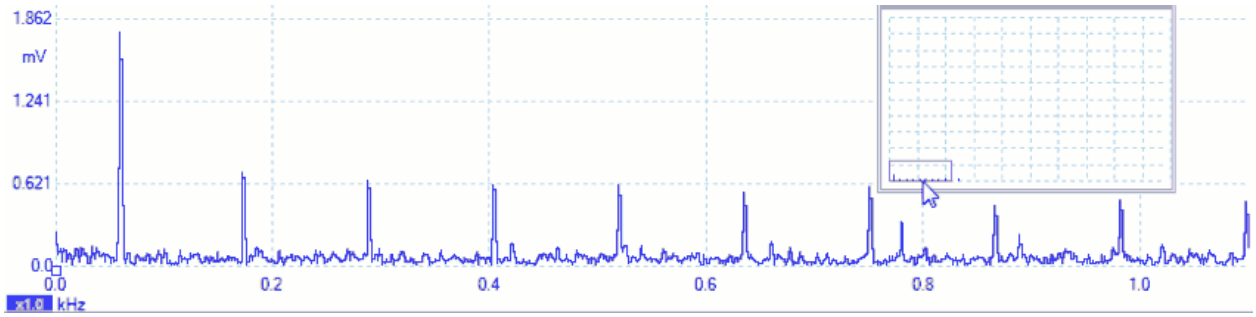
Site D: Home owner name withheld by request

Vertical Magnetic field. Major Positive and Negative spikes characteristic of non-linear loads, such as plasma lighting (fluorescent, high pressure sodium, etc.)

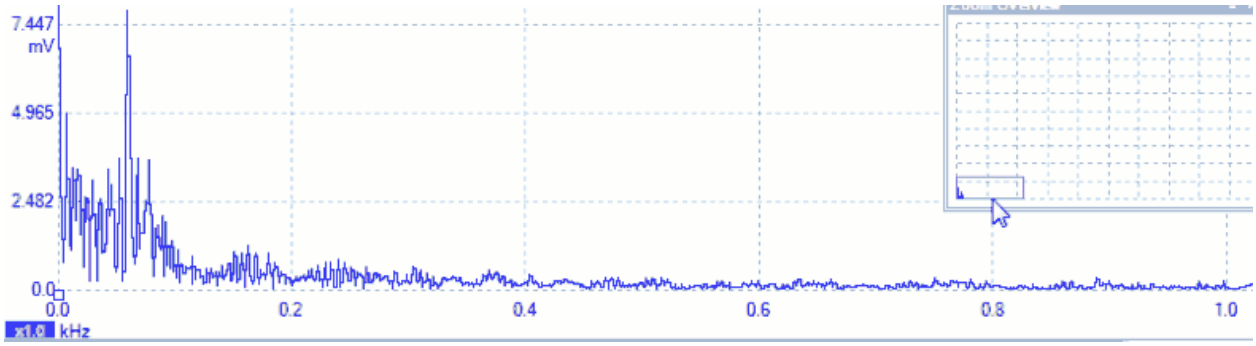




Vertical Magnetic *Field. Note 60 Fundamental (first major spike), and generous EMI with prominent peaks at about 1.5 and 1.8 KHz*

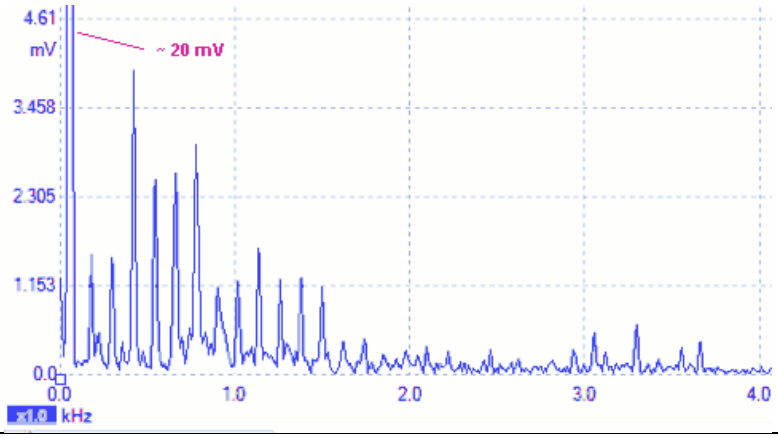


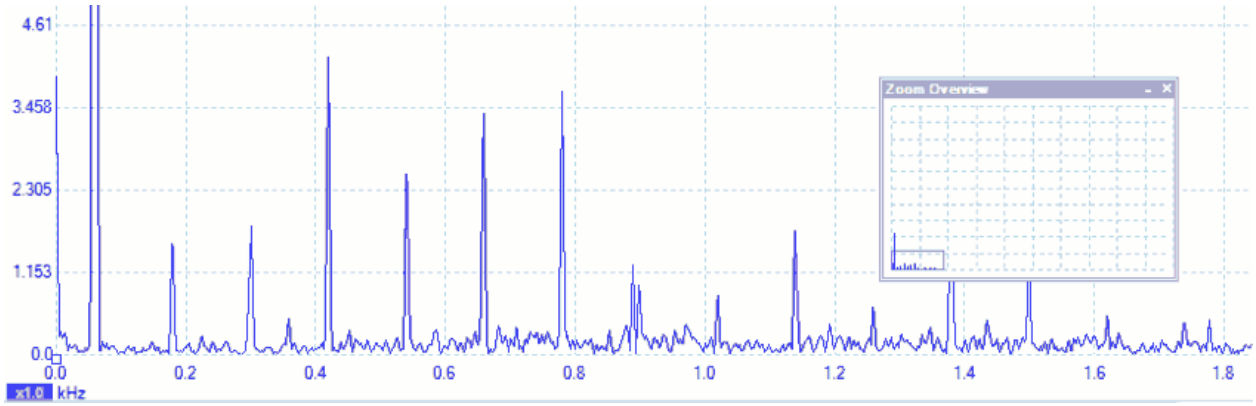
Vertical Magnetic *Field. Note that 60 Hz and Harmonics were intermittent with obscuring EMI.*



Vertical Magnetic *Field EMI, intermittent with 60 Hz and Harmonics*

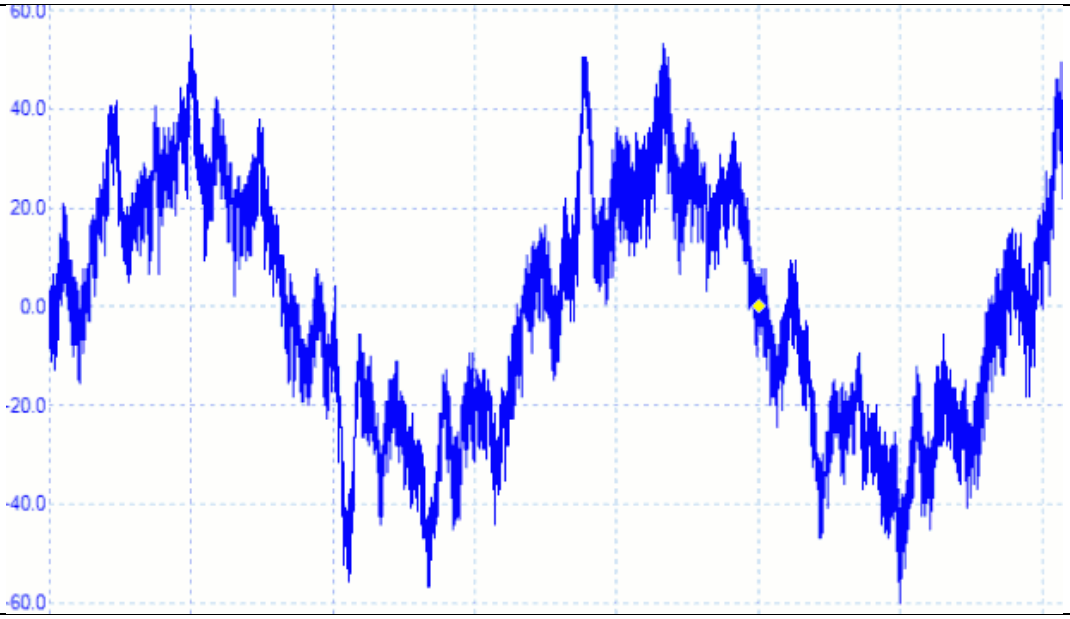
Horizontal Magnetic *Field, several power frequency harmonics among the pervasive electrical "noise" (EMI)*





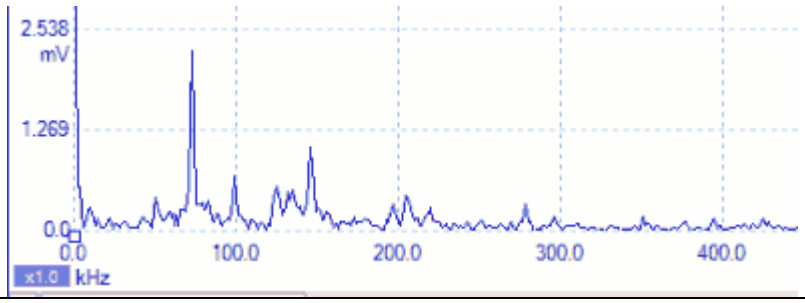
Horizontal Magnetic *Field with Fundamental(60 Hz) and Harmonics, Close-up*

Vertical Magnetic Field

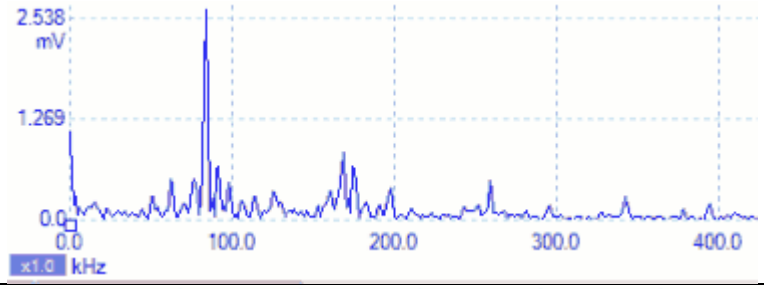


Site E: David Elliott, Jr.'s

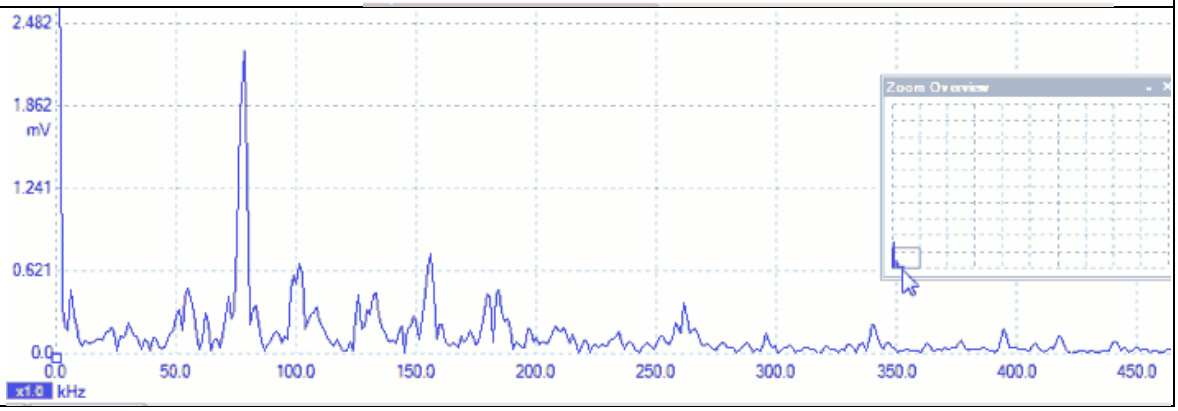
Electric Field *EMI, its character varied slightly in frequency, but was sputtering continuously between 60 Hz and 400 KHz*



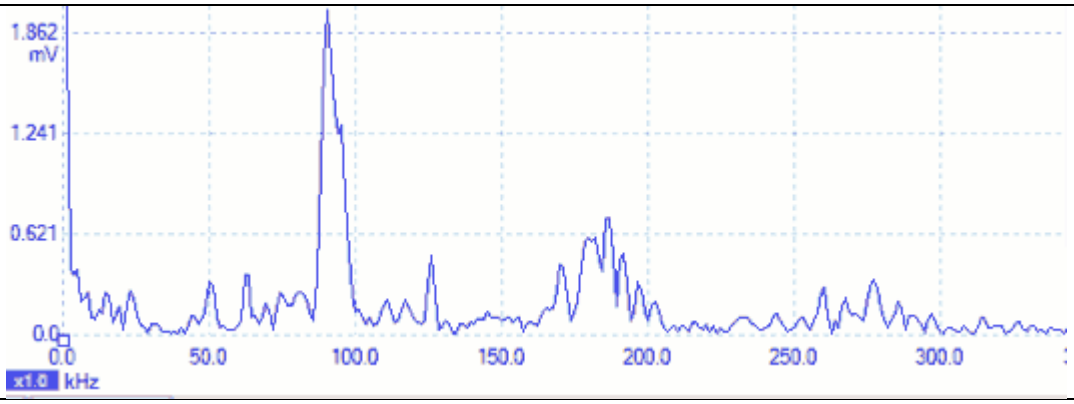
The same EMI a few seconds later



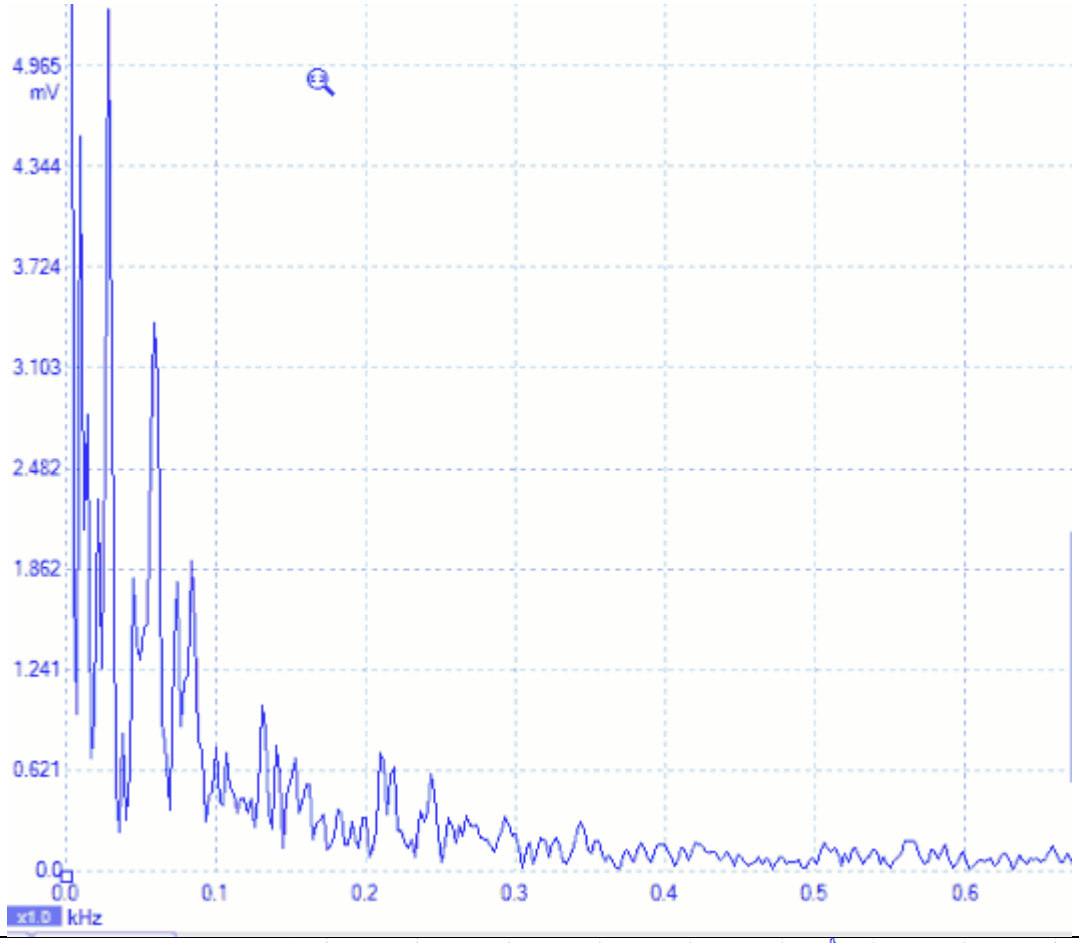
A close-up



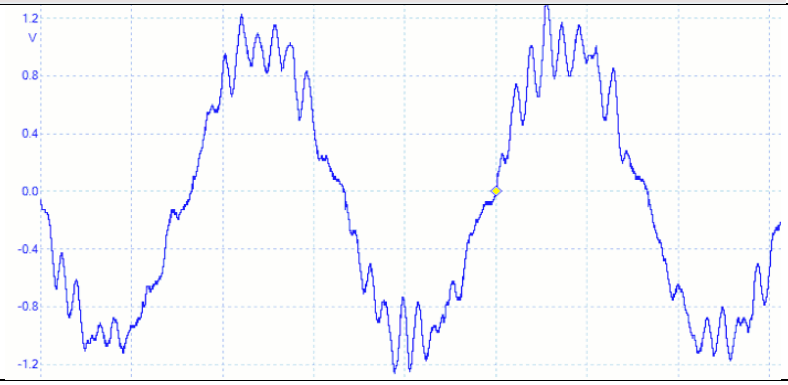
The same EMI a few seconds later



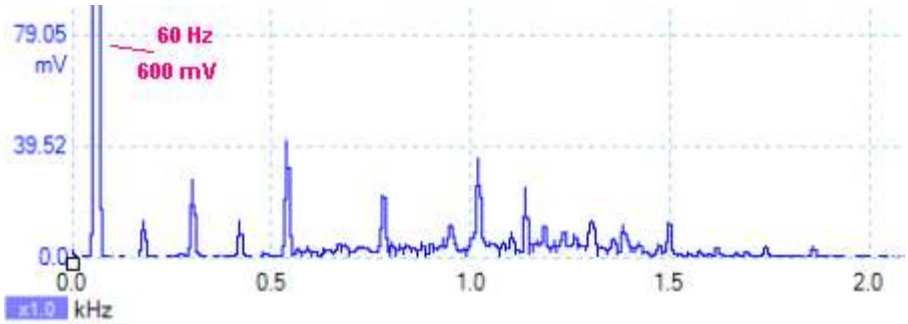
Major equipment starting transient, around midday

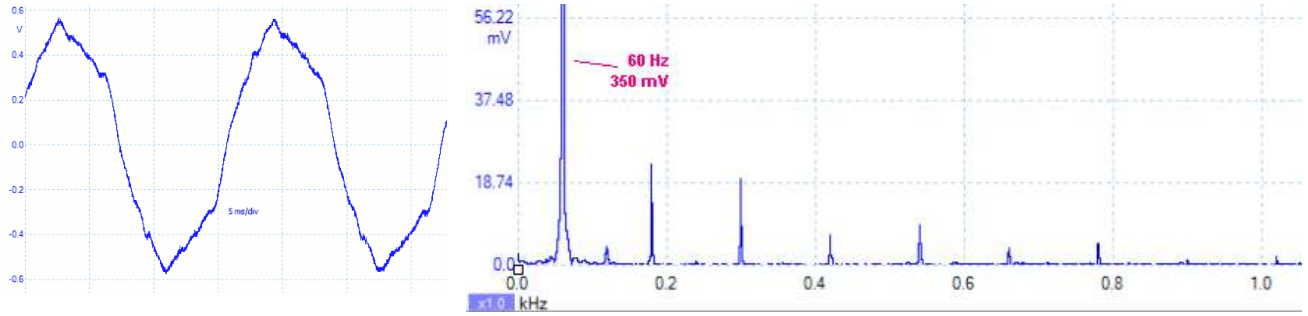


Sampling of an energized lead voltage *at the electrical panel. The vertical scale should be multiplied by 140, as the peak in either direction is 170 Volts, for the standard 120 Volts residential service. Under normal loads the Voltage should Not vary as significantly as shown, and suspect this to be external.*

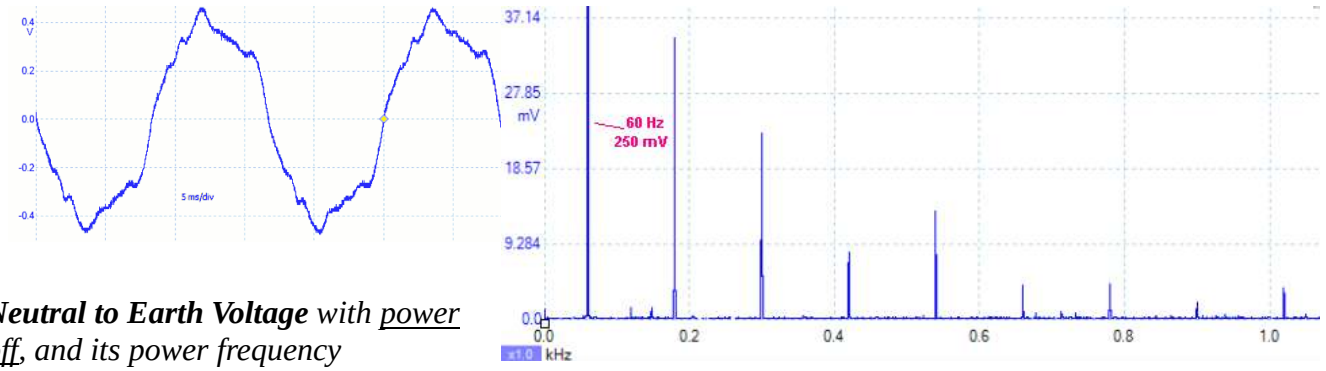


The spectrum of the ***energized lead voltage*** *at the panel. Power Frequency Harmonics and background EMI.*





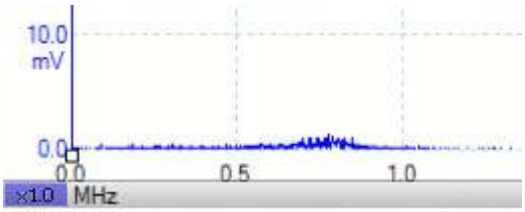
Neutral to Earth Voltage *with power on, and its power line harmonics*



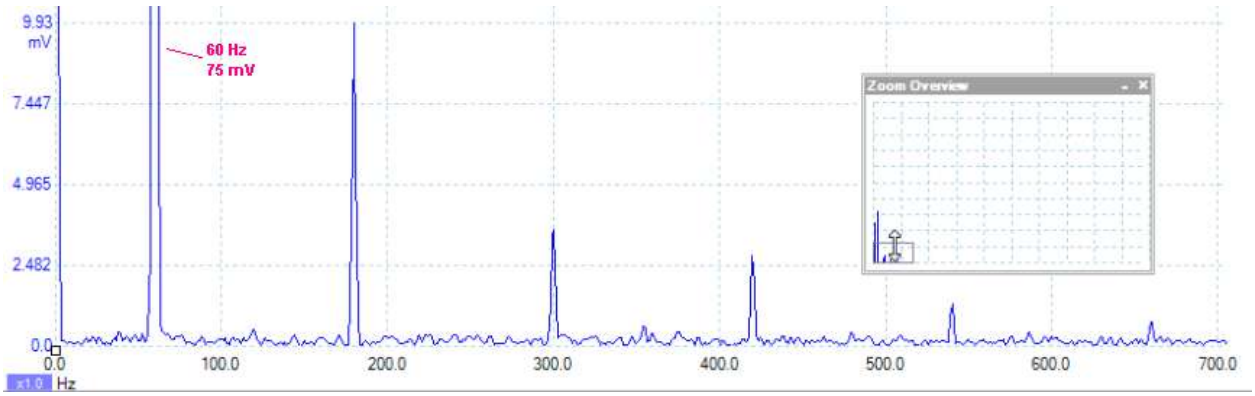
Neutral to Earth Voltage *with power off, and its power frequency harmonics. Note that although the 60 Hz is reduced, the Harmonics increased in size.*

Site F: Home owner name withheld by request

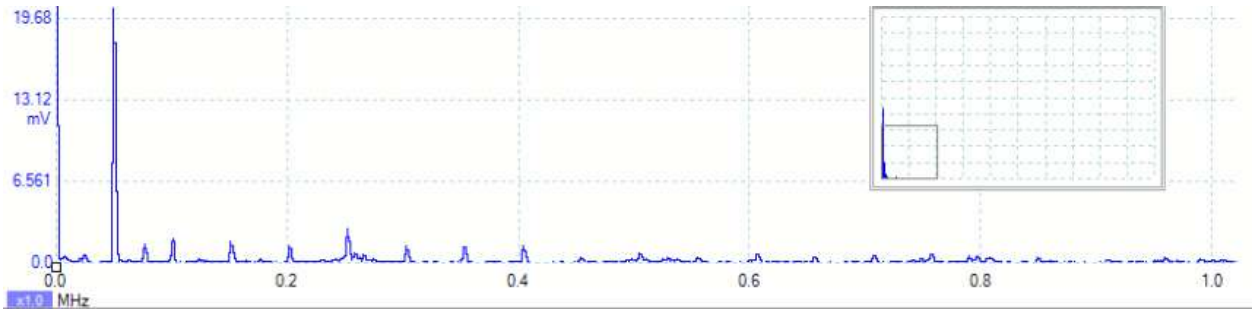
Vertical Magnetic Field *pickup with EMI induction into test leads between about 500 KHz and 1 MHz*



EMI close-up

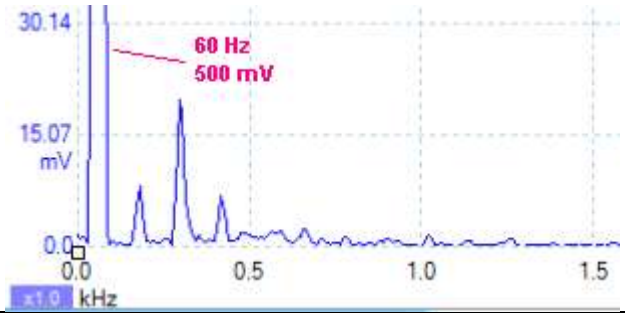


Horizontal Magnetic *field, power frequency harmonics and electrical "noise"*

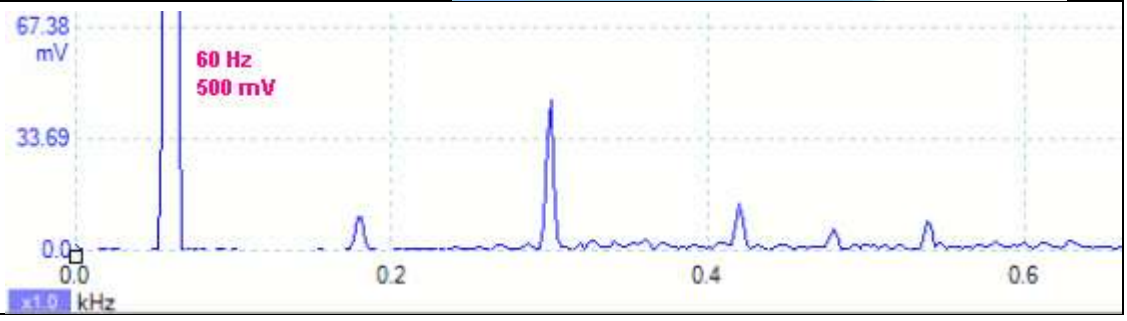


Electric field *pickup. Note these are not power frequency harmonics, but EMI*

Electric field *pickup with some power frequency harmonics, intermittent with the EMI – Note how the same harmonic size relationships are maintained when a sample is taken off a bus voltage in the panel (below), because in the transformer any components in the Primary will appear on both buses of the Secondary, and therefore in every wire in the house.*

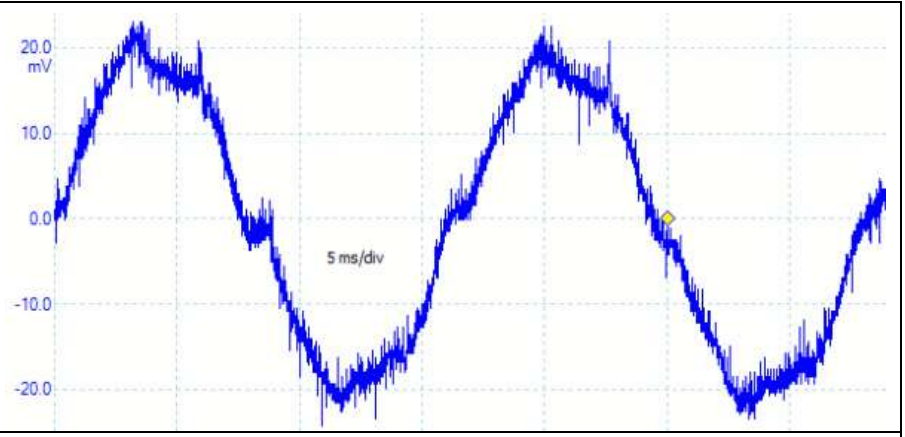


Sampling of an energized lead voltage *at the electrical panel,* <u>*with power off.*</u> *Sampled before the breaker.*



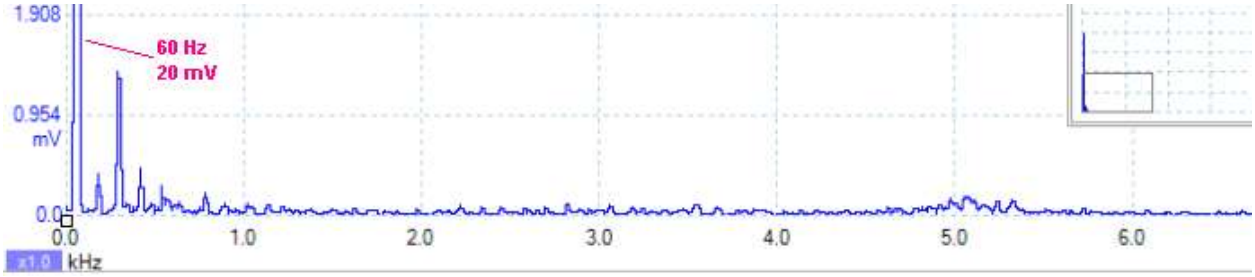
Site G: Lance Conway's

Horizontal Magnetic *field, intermittently fluctuating between 15 and 30 mV peak*



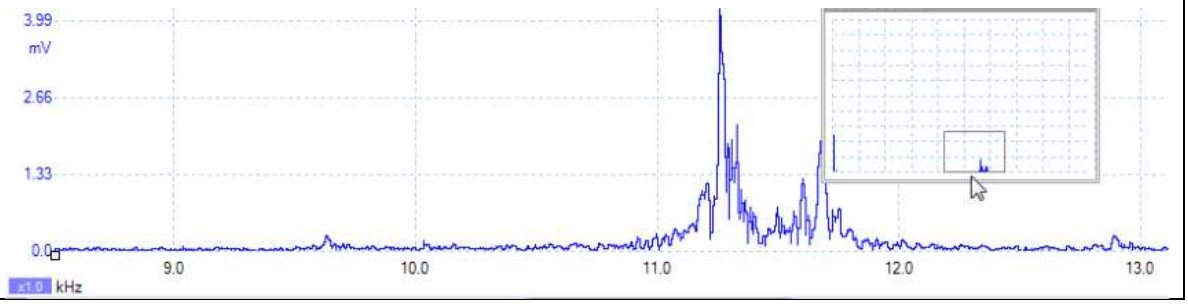
What appears to be power frequency harmonics to 2 MHz

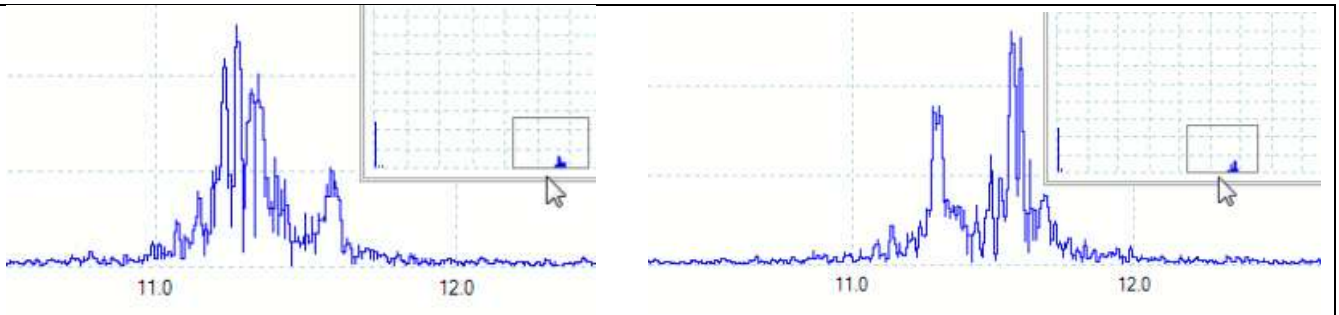
Very pronounced EMI at about 27.5 KHz



Power Frequency harmonics (first block), and EMI

Unknown EMI – very similar to Ginger's house at 16 KHz

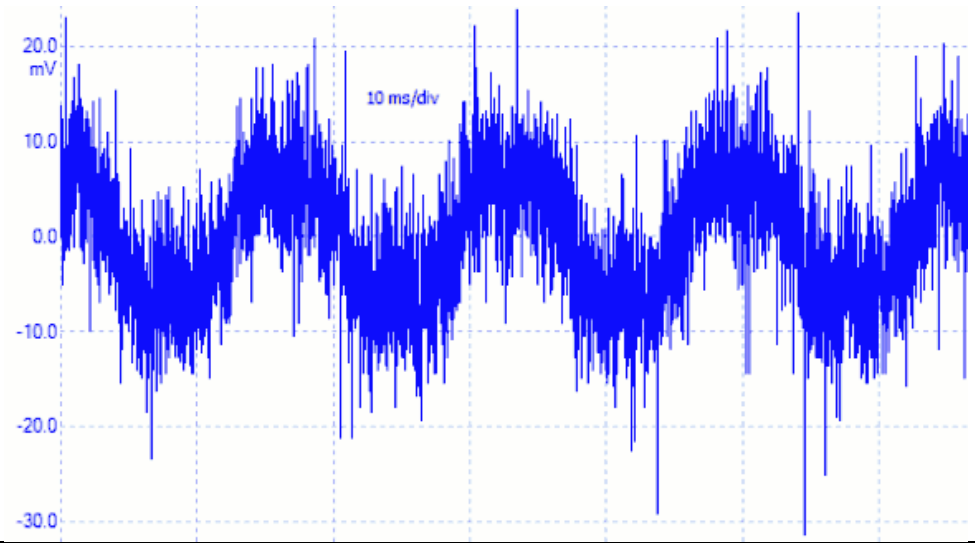




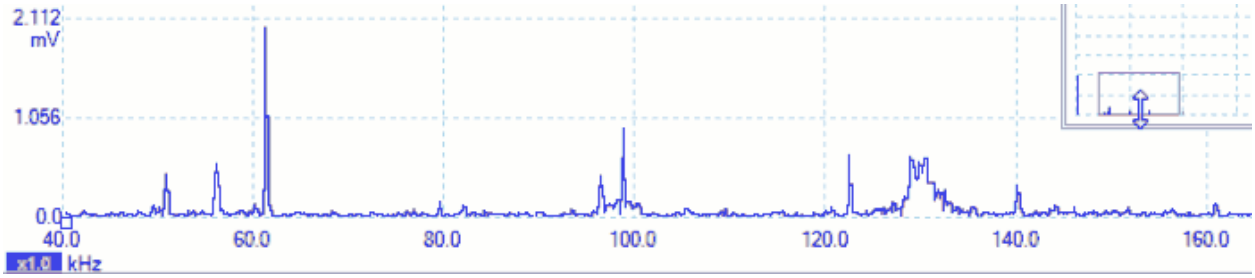
Two views of the same EMI as above, seconds apart

Site H: By Turbine

Electric field *pickup on a long wire (~ 20') horizontal antenna*



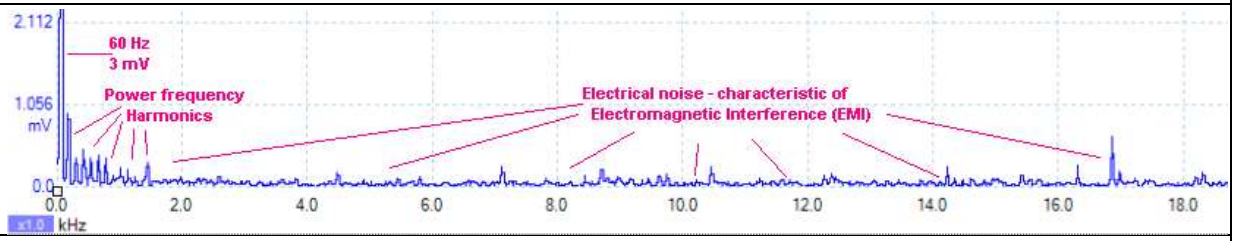
Power frequency harmonics?



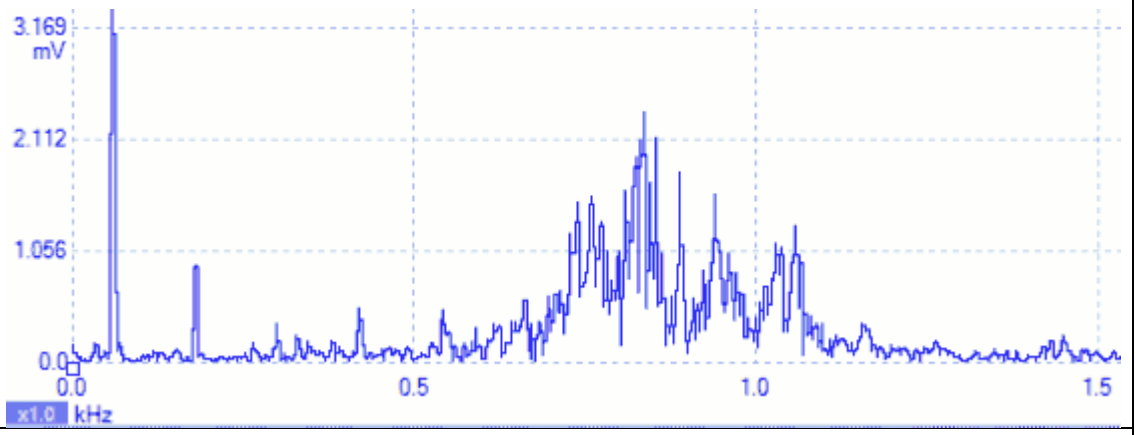
Wide-band EMI, each group sporadically going up and down in frequency

Same as previous EMI, a few seconds later

Harmonics and EMI



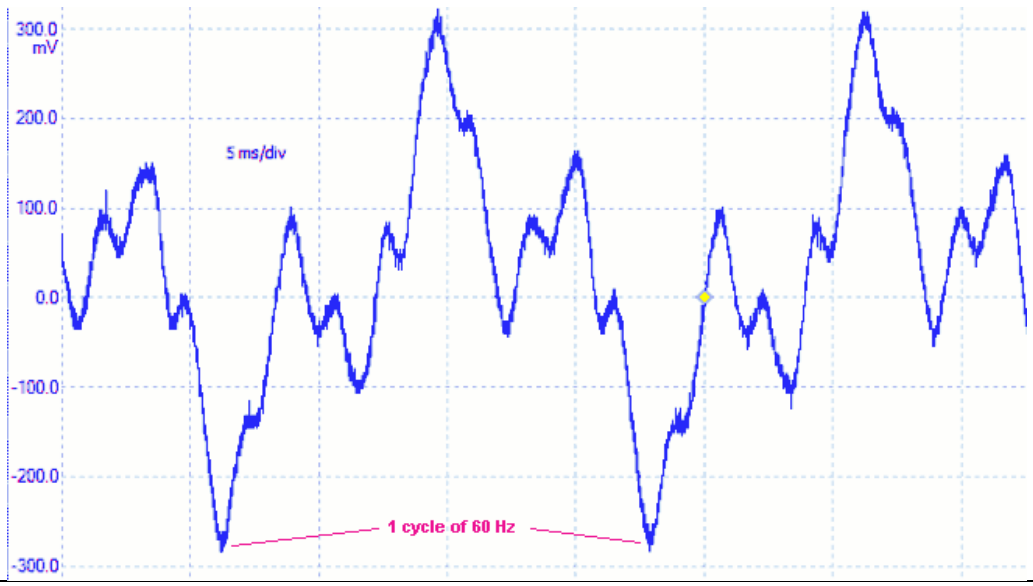
A few harmonics and much EMI



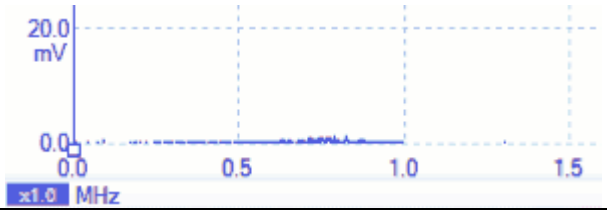
Magnetic field pickup, EMI

Site I: SDG & E Boulevard Substation

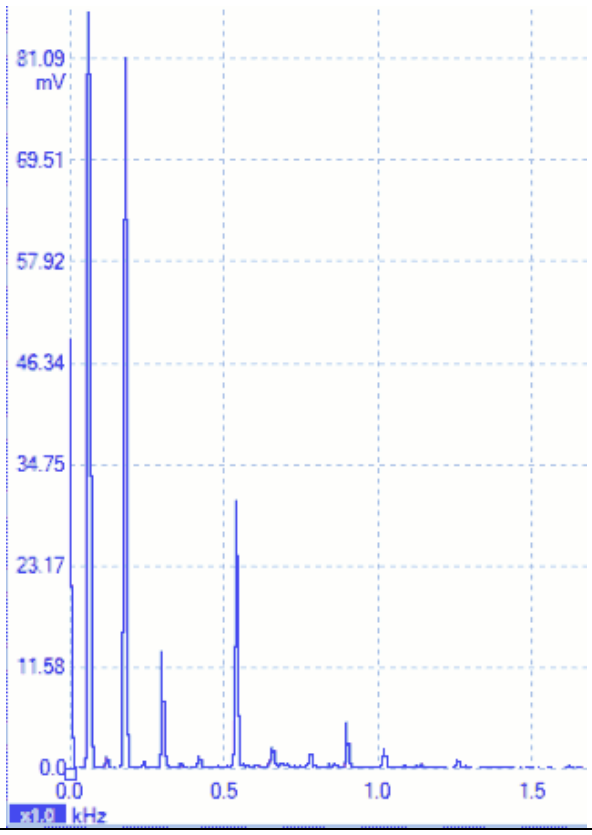
Vertical Magnetic *field, Ground Current returning to sub – Note that this is three-phase power, as identified by the peculiar peak arrangement for each cycle of 60 Hz*



Wide-band EMI, same as at Site F, and Ginger's, and very similar to Rowena's

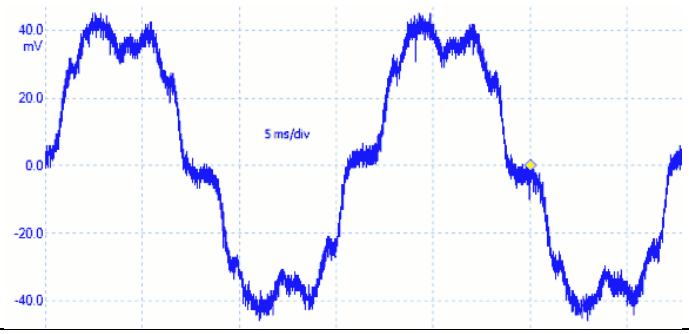


Power frequency harmonics

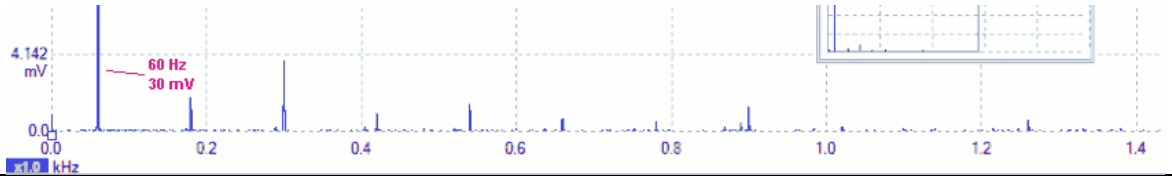


Site J: Jim Pelley's

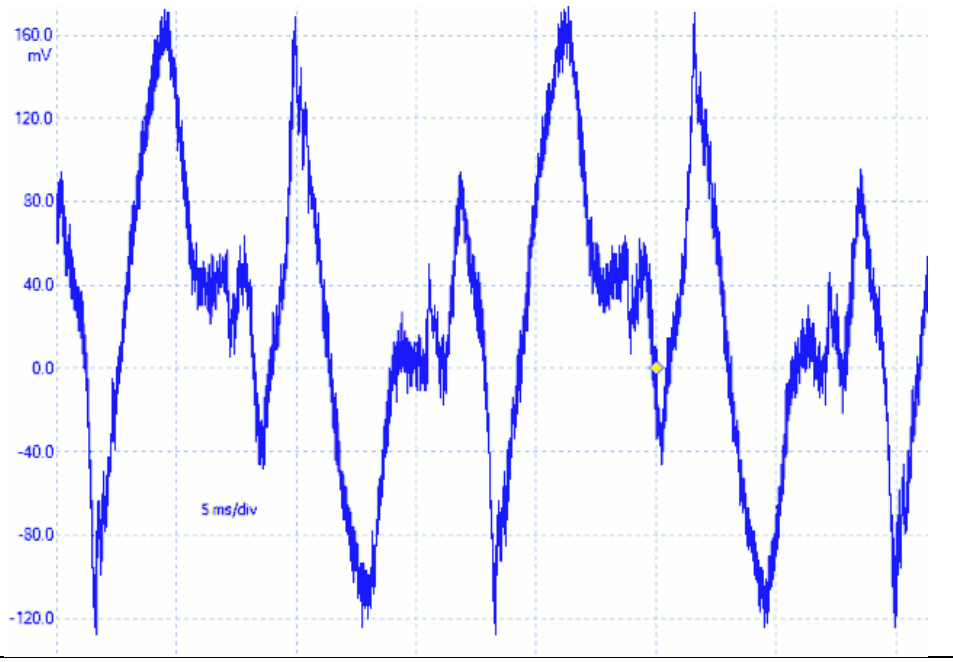
Horizontal Magnetic *field over the underground feed to the house, with power on. This is a combination of grounding current for the power system as well as the house. Is the primary contributor the power line, or the user appliances? Note that there is a three-phase signature, which is clearer on the next page with a power off measurement.*



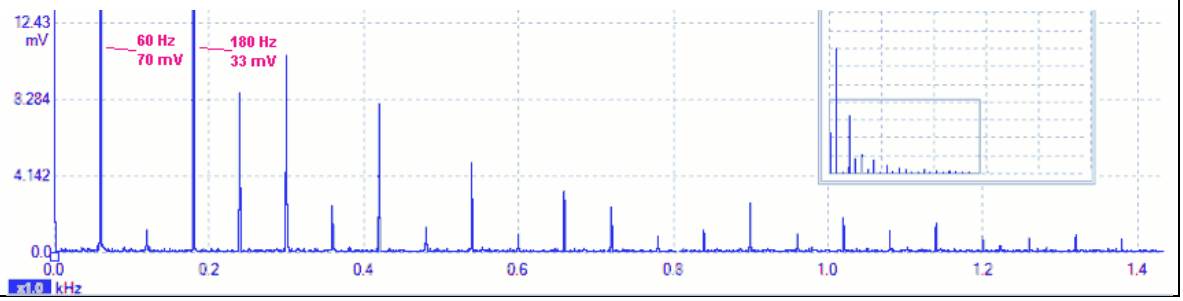
And its corresponding spectrum



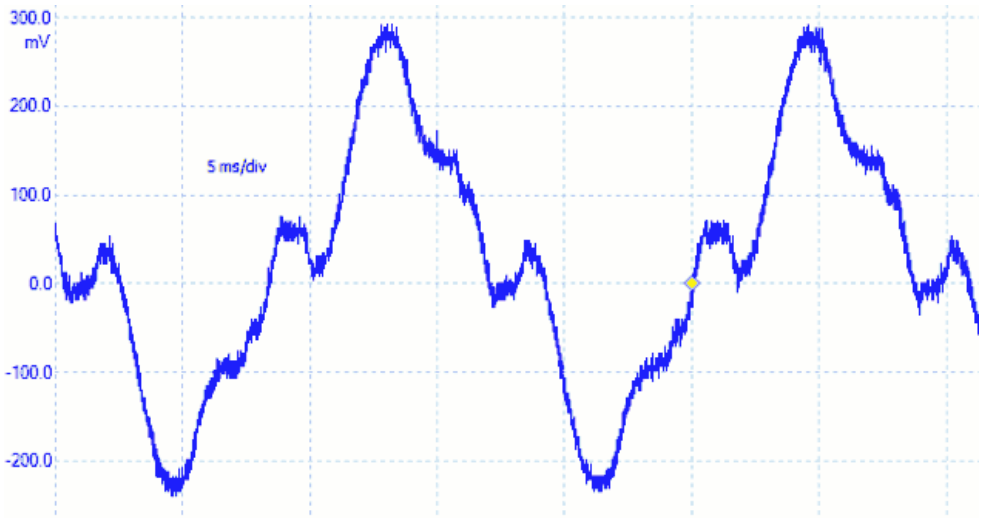
The same measurement, about one minute later. Is the primary contributor the power line, or the user appliances?



And the corresponding spectrum

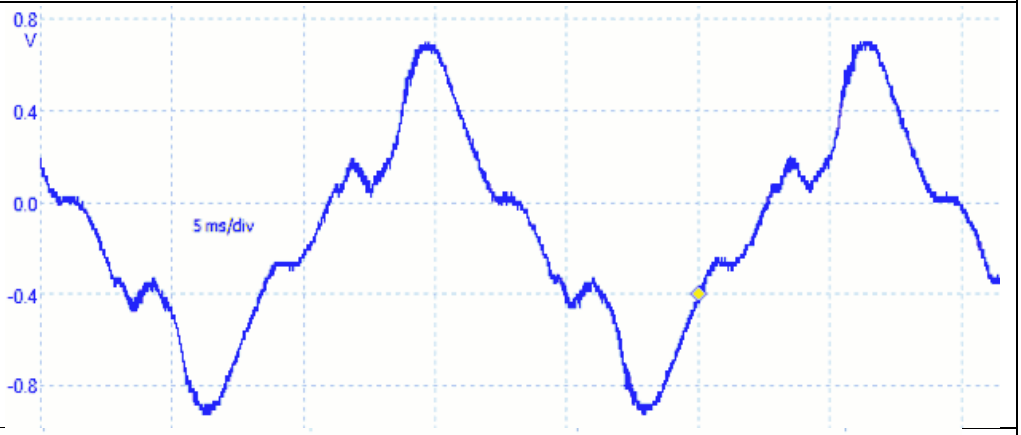


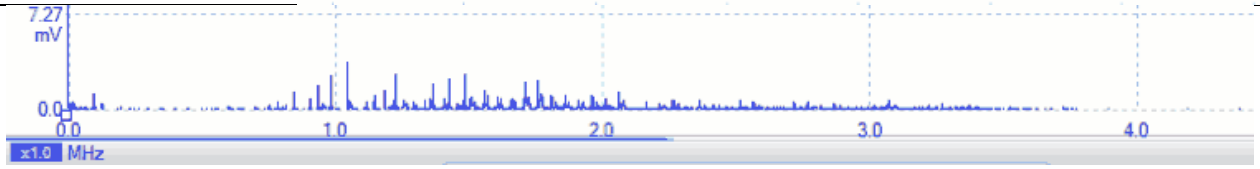
Horizontal Magnetic *field over the underground feed to the house, with power off. Note that this is three phase power grounding current. Even though the supply to the house is single phase, the imbalance on Primary Neutral from the 3-phase system is using the residence ground to return current back to the substation.*



Electric field pickup with wide-band EMI

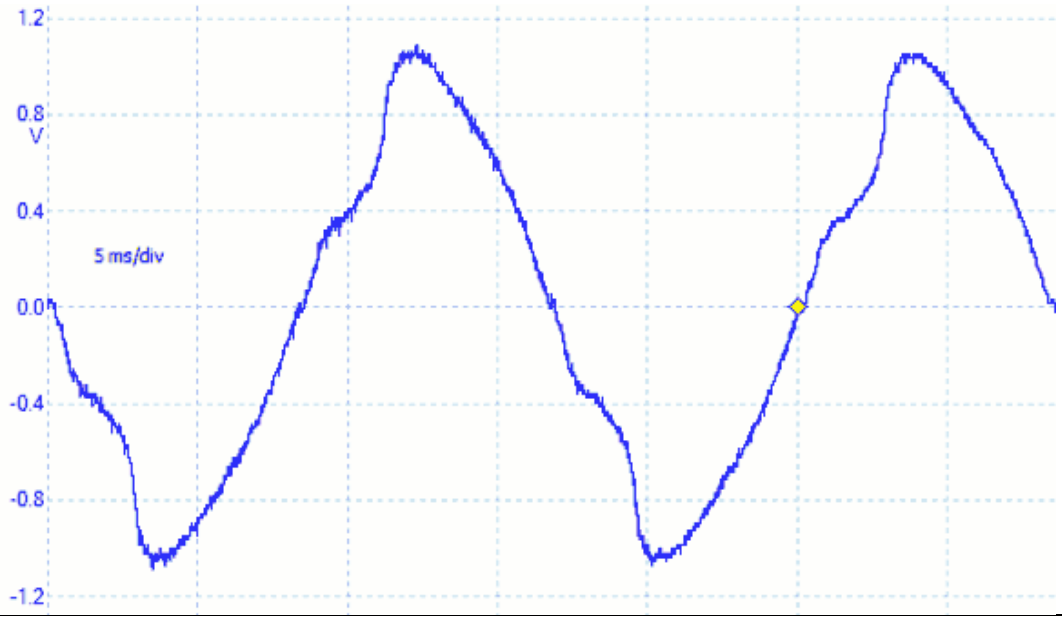
Neutral to Earth voltage *with power off. Note that this is a three-phase signature.*

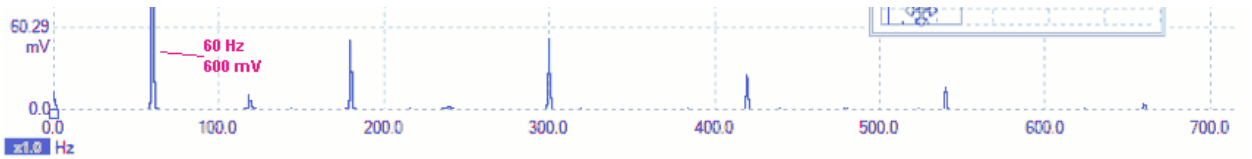




Neutral to Earth voltage *with power off – wide-band EMI*

NET current *contribution from residential use to the Neutral, which would share some of its current through the soil. The scale is 100 mV/A, equating to about 7.5 Amps. Perhaps 30% of this will find its way back to the source via the soil.*

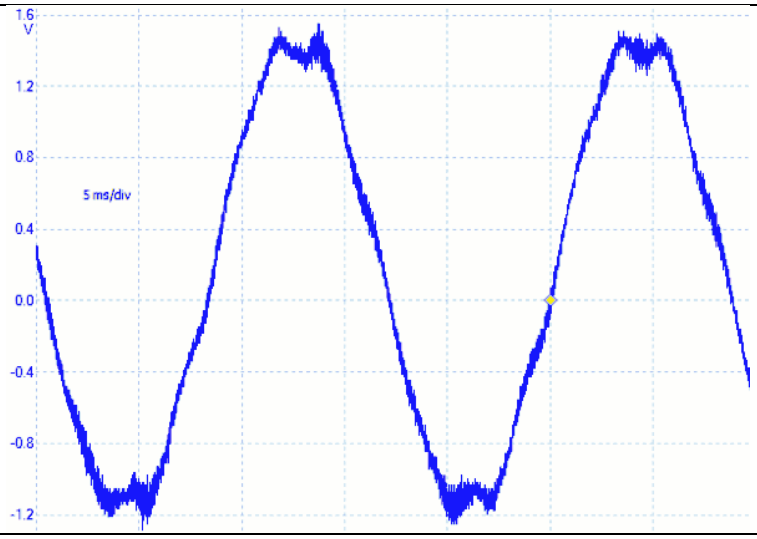


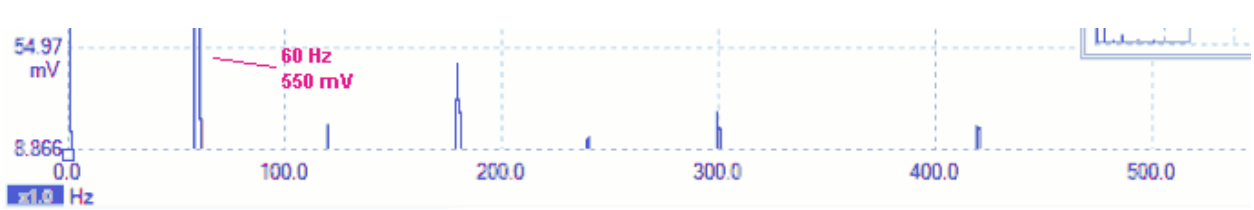


And its corresponding spectrum. Note the relatively few power frequency harmonics.

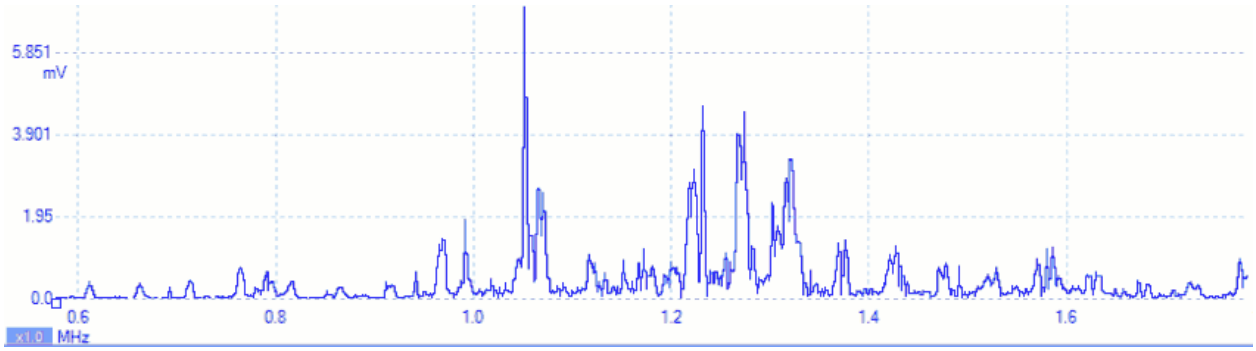
Site K: Parke Ewing's

Neutral to Earth Voltage with power off.





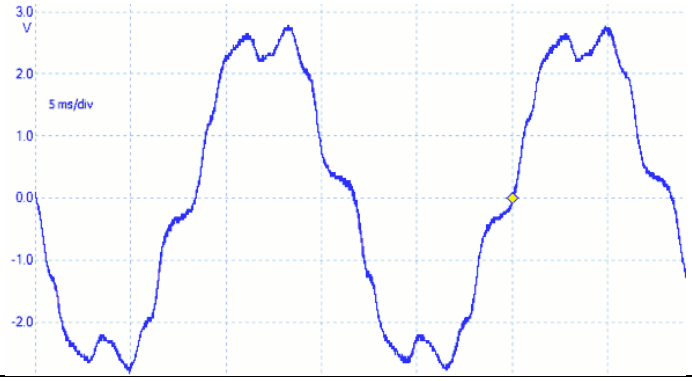
And the corresponding spectrum.

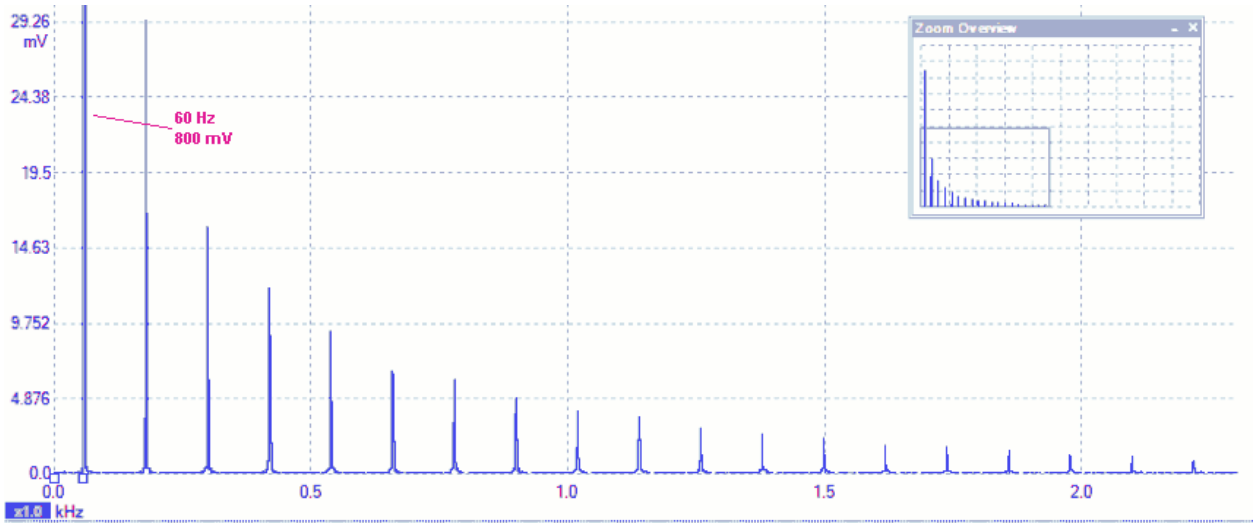


Neutral to Earth Voltage with power off – wide-band EMI

A bus voltage with power on.

B bus nearly identical.





And the corresponding spectrum.